Summary of "Alberta Avoids the Hospitalization Epidemic for Congestive Heart Failure Patients"

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visualize blood supply to the heart, surgery to increase blood supply to the heart).

Conclusions

The burden of heart failure decreased in Alberta at a time when other provinces and countries had noted an increase. As well, the study did not find an increase in non-hospitalized congestive heart failure as a possible compensation for the decrease in hospitalization. The reasons for the decrease are beyond the scope of this present study and must focus upon those at risk of developing the condition. It is plausible that increased utilization of specialty health services for patients at high risk of developing heart failure care (i.e. hypertension) may have decreased the onset of new heart disease cases.

For More Information

Copies of the report are available from the

Alberta Centre for Health Services Utilization Research

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Alberta Centre for Health Services Utilization Research

The Alberta Centre for Health Services Utilization Research is a joint initiative between the University of Alberta and the University of Calgary, funded by Alberta Health and Wellness. The Centre conducts studies of how health services are used and delivered to inform health policy development and management of health services delivery.

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Purpose

Heart failure is a common diagnosis for hospital admission in Alberta and other industrialized countries. The rate of admission to hospital for heart failure has increased to such an extent that the label "epidemic" has been used. The increase in heart failure hospitalization may be related to an aging population or increased survival after a heart attack. Improvements in therapy directed to those at risk of developing heart failure may actually prevent new cases of heart failure from developing.

In this study patients diagnosed for heart failure at the time of hospitalization and patients diagnosed in specialists offices without a prior hospitalization for heart failure were assessed. Outcomes assessed and measured included in-hospital mortality, one-year mortality, hospitalization costs, length of hospital stay, and re-admissions to hospital.

Approach

Three Alberta administrative health service databases were used to obtain data between April 1, 1995 to March 31, 2000.

Key Findings

The following are the key findings:

- During the six years of the study, there were 16,162 hospitalizations for newly diagnosed heart failure. These new hospitalizations represent fifty percent of the total hospital admissions for heart failure (n = 32,139) during the study period.
- New cases of heart failure hospitalization per 1,000 population decreased between 1994/1995 (1.59) and 1999/2000 (1.24).
- The total number of heart failure hospitalizations per 1,000 population also declined between 1994/1995 (2.98) and 1999/2000 (2.55).
- Ambulatory diagnosis of heart failure per 1,000 population was similar throughout the 1994/1995 to1999/2000 time.
- Length of hospital stay, mortality, hospital re-admissions, and hospital costs were similar between 1994/1995 and 1999/2000.
- During the study period, there was greater use of specialty health services (admission to metropolitan hospitals with capability to visualize blood supply to the heart, internal medicine and cardiology specialist physician care, tests to

Alberta Avoids the Hospitalization Epidemic for Congestive Heart Failure Patients

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TABLE OF CONTENTS

Summary 1
Introduction 2
Methods 3
Study Population: 3
Inclusion Criteria: 3
Exclusion Criteria: 3
Covariates: 4
Patient Characteristics: 4
Comorbidity: 4
Hospital Volume: 5
Congestive Heart Failure Outcomes: 5
Length of Stay: 5
Hospital Costs: 5
180-Days Readmission to Hospital: 6
Mortality: 6
Statistics 6
Results 7
Discussion 8
References 10
Figure Legend 14
Figure 1a – Age-Sex Standardized Yearly Prevalence in Patients With Congestive Heart Failure 14
Figure 1b – Age-Sex Standarized Yearly Incidence in Patients With Congestive Heart Failure 15
Figure 1c – One-Year Mortality Rate in Yearly Congestive Heart Failure Incidents ... 16
Figure 1d – Crude Hospital Discharge Rate in Patients With Congestive Heart Failure 17
Table 1 – Patient Characteristics (Number and Percent) of Patients Hospitalized for Congestive Heart Failure in Alberta During 1994/1995 to 1999/2000 18
Table 2 – Patient Severity and Comorbidity (Number and Percent) of Patients Hospitalized for Congestive Heart Failure in Alberta During 1994/1995 to 1999/2000 19
Table 3 – Patient Utilization of Resources (Number and Percent) for Patients Hospitalized for Congestive Heart Failure in Alberta During 1994/1995 to 1999/2000 20
Table 4 – Unadjusted Outcomes (Number and Percent) for Patients Hospitalized for Congestive Heart Failure in Alberta During 1994/1995 to 1999/2000 21
Table 5 – Adjusted Outcomes and Their Ninety-Five Percent Confidence Interval for Patients Selected Hospitalized Congestive Heart Failure in Alberta During 1994/1995 to 1999/2000 22

Biographies **23**
Bibiana Cujec, M.D., FRCPC 23
Yan Jin, M.A. 24
Hude Quan, M.D., Ph.D. 25
David Johnson, M.D., S.M., M.B.A. 26

SUMMARY

We assessed the incidence and prevalence of congestive heart failure in patients diagnosed at the time of hospitalization and patients diagnosed in specialists' offices without prior hospitalization. We used Alberta hospital discharge and physician claims administrative data from April 1, 1994 to March 31, 2000.

We found a small but statistically significant decline in the age-sex incident and prevalent hospitalization rates for congestive heart failure between 1994/1995 (incidence per 1,000 of 1.59; ninety-nine percent CI 1.51, 1.66: prevalence per 1,000 of 2.31; ninety-nine percent CI 2.22, 2.40) and the year 1999/2000 (incidence per 1,000 of 1.24; ninety-nine percent CI 1.18, 1.30: prevalence per 1,000 of 1.97; ninety-nine percent CI 1.89, 2.05). Crude hospitalization rate per 1,000 also demonstrated a small but statistically significant decline between 1994/1995 (2.98; ninety-nine percent CI 2.88, 3.08) and 1999/2000 (2.55; ninety-nine percent CI 2.46, 2.64). The age-sex incident rates of ambulatory diagnosis of congestive heart failure were similar throughout the 1994/1995 to 1999/2000 time period (0.88; ninety-nine percent CI 0.82, 0.94 during 1994/1995 and 0.84; ninety-nine percent CI 0.79, 0.89 during 1999/2000). The crude mortality percentages for incident hospitalization for congestive heart failure were similar throughout the 1994/1995 to 1999/2000 time period (31.0 percent; ninety-nine percent CI 28.7, 33.3 during 1994/1995 and 28.6 percent, ninety-nine percent CI 26.3, 30.9 during 1999/2000).

In conclusion, we noted a small decrease in the incident, prevalent, and total hospitalizations for congestive heart failure in the time period 1994/1995 to 1999/2000. The decrease was not the result of a substituted increase in ambulatory diagnosis for congestive heart failure. The reasons for the decrease in Alberta, in contrast to the increase noted in other studies, is unknown.

INTRODUCTION

Congestive heart failure (CHF) is the most common diagnosis for hospital admission in the United States [1] and other industrialized countries [2-6]. The rate of admission to hospital for congestive heart failure has increased to such an extent that the label "epidemic" has been used [1, 2, 7, 8]. The increase in congestive heart failure hospitalization may be related to demographic changes in an aging population or related to enhanced survival from acute ischemic heart disease (the most common cause of congestive heart failure) [1, 9]. Despite the increased hospitalization for congestive heart failure, mortality also declined suggesting innovations in therapy may have improved outcome [10, 11]. These innovations in therapy include enhanced use of diagnostic procedures and if warranted revascularization [10-14]. The increased use of diagnostic and revascularization therapy may subsequently decrease mortality in those patients with congestive heart failure [13-18]. Improved therapy may also be directed towards ischemic heart disease or hypertension and actually primarily prevent new cases of congestive heart failure developing. In this manner, incidence and eventually prevalence of congestive heart failure may actually decline.

In this study, we use administrative data from one Canadian province to assess the incidence and prevalence of congestive heart failure in the six-year time period from April 1, 1994 until March 31, 2000. In order to capture the entire cohort of patients with congestive heart failure, we assess patients diagnosed at the time of hospitalization and patients diagnosed in specialists' offices without a prior hospitalization for congestive heart failure. Measured outcomes were in-hospital mortality, one-year mortality, hospitalization costs, length of hospital stay, and readmission to hospital.

METHODS

Three administrative health service databases were used and the analysis was done within the protected environment of Alberta Health and Wellness, which is governed by provincial legislative guidelines on the confidentiality of health information:

1. Canadian Institute for Health Information's (CIHI) Inpatient Discharge Abstract Database (DAD) for the province of Alberta for fiscal years 1992/1993 to 1999/2000,
2. Alberta Health Insurance Plan Registry File for fiscal years 1992/1993 to 1999/2000, and
3. Alberta Physician Claims Assessment System Database for 1995/1996 to 1999/2000.

Study Population:

Inclusion Criteria:

1. Congestive heart failure was defined using the fifteenth International Classification of Disease, Ninth Revision, Clinical Modification (ICD-9-CM 428.x, 398.91, 402.x1, 404.x greater than 0, 514.x, 518.4, 425.9) in the most responsible diagnosis field of the CIHI DAD hospital abstract [19, 20], and
2. Office or ambulatory care internal medicine specialist or sub-specialist consultation claim (CPX 03.x) [21] for congestive heart failure as defined by ICD-9-CM above.

Exclusion Criteria:

1. Not an Alberta resident,
2. Age < 20 or age > 105,
3. Not admitted to an Alberta acute care facility,
4. No hospitalization for congestive heart failure (as the most responsible diagnosis) during the two years prior to index encounter,
5. For incident cases only: no duplicate hospital discharges within the five study years, and
6. For hospitalized cases only: no previous internal medicine specialist or sub-specialist consultation claim for congestive heart failure (defined as for hospitalizations) as the most responsible diagnosis during the two years prior to index encounter.

Covariates:

Patient Characteristics:

1. Age (20 to 49, 50 to 64, 65 to 75, 75 to 84, and 85 and over),
2. Sex (female versus male),
3. Year of congestive heart failure hospital discharge,
4. Region of residence (seventeen health regions in Alberta were grouped into two metropolitan regions, Calgary, Edmonton and one non-metropolitan region),
5. Export (admission to a hospital located in a region not within region of residence),
6. Resident of continuing care prior to hospital admission, and
7. Transfer to another acute care hospital.

Comorbidity:

The seventeen comorbidities that constitute the Charlson index [22, 23] were defined using Deyo's coding algorithm and the fifteen supplemental diagnosis fields in the CIHI DAD hospital abstract. The Charlson comorbidities were aggregated into none, one, and two or more of the individual conditions Polanczyk's comorbidities [24] were defined as:

1. Anemia (ICD-9-CM 280.xx to 285.xx),
2. Hyponatremia and other electrolyte disturbance (ICD-9-CM 276.x),
3. Coronary artery disease (ICD-9-CM 411.xx, 413.xx, 414.xx),
4. Hypertension (ICD-9-CM 401.xx to 405.xx),
5. Valvular heart disease (ICD-9-CM 394.xx to 398.xx, 424.xx),
6. Ventricular arrhythmia (ICD-9-CM 427.4x, 427.5x, 427.6x), and
7. Hypotension and shock (ICD-9-CM 458.xx, 785.5x).

We also recorded:

1. Transferred to another acute care hospital (all outcomes attributed to first hospital contact),
2. Special care unit admission (hospital defined), and
3. Cardiac catheterizations (see below). A severity score [24] was defined and assigned to each patient using the following weighting method: one point per decade of age greater than forty years plus two points for each of transferred admission, cerebral vascular disease, chronic obstructive lung disease, hyponatremia, other electrolyte disturbance, metastatic disease) plus four points for moderate to severe renal disease plus six points for ventricular arrhythmia, mild liver disease, or malignancy) plus thirteen points for hypotension or shock.

Health services associated congestive heart failure in the year following initial diagnosis:

1. Cardiac catheterization (Physician claims CPX 48.92A, 48.98A, 48.98B, 49.96A, 49.96B),
2. Percutaneous transluminal coronary angioplasty / stenting (Physician claim CPX 51.59C), and
3. Coronary artery bypass surgery (Physician claims CPX 48.0 A, 48.12, 48.12A, 48.13, 48.13A, 48.14, 48.14A, 48.15A, 48.15B, 48.15C, 48. 15D, 48.15E, 48.15F, 48.15G, 48, 15H, 48.19A).

Hospital Volume:

At the time of this study, an autonomous regional board in each of the seventeen health regions administered all hospitals, in Alberta. Nearly all of the three million residents of Alberta enrolled in the public health care insurance plan reside in one of the seventeen health regions. Alberta hospitals admitting congestive heart failure patients were categorized into five groups on the basis of the total number of congestive heart failure separations between April 1, 1994 until March 31, 2000 and geographic location.

1. Rural hospitals were based on the fiftieth percentile volume in rural areas. Seventy-seven hospitals had less than 200 cases and twenty-five hospitals had 204 to 646 cases,
2. Regional hospitals (five) located in one of the five non-metropolitan regional health care cities had 238 to 646 cases,
3. Metropolitan hospitals (six) located in the metropolitan health region of Calgary and Capital without angiography capability had 327 to 2,199 cases, and
4. Metropolitan hospitals (three) located in the metropolitan health regions of Calgary and Capital with angiography capability had 1,793 to 2,700 cases.

Congestive Heart Failure Outcomes:

Length of Stay:

Length of stay was calculated as days between discharge and admission date. Transfers (defined as readmission to different hospitals within one day) were attributed to the index admission and cumulative hospital length of stay calculated for an episode of care. Length of stay in regressions are restricted to those discharged alive.

Hospital Costs:

Inpatient costing per resource group number (RGN – an Alberta refinement of Diagnosis Related Groups) was calculated using the provincially approved methodology as set forth by the Provincial Costing Project and in accordance with the Provincial and National Management Information Systems guidelines [25, 26]. Total costs combine

allocation and assignment of all direct and indirect costs associated with an inpatient encounter from the time a patient is admitted to the hospital to the time they are discharged. All costs per RGN were estimated using 1998/1999 costs and assumed similar for all the study years. All costs for episode of hospital care were attributed to the index separation. The quality of the data reporting of costs in Alberta has been highly ranked by Canadian Institutes for Health Information [27]. As such, the methodological issues that arise around collection of cost data in the United States [28], in part due to the use of prices rather than costs, and for centres in Canada which cost admissions on the basis of "case-mix grouping" do not arise with the majority of the cost data considered in this analysis.

180-Days Readmission to Hospital:

The 180-days readmission to hospital is defined as the first readmission to any acute care hospital within 180 days for those alive at hospital discharge for acute myocardial infarction.

Mortality:

Vital statistics declaration of death certificates were merged with the Alberta Health and Wellness Premium Registry databank in order to determine de-registration from the plan. The one-year mortality rates were defined as deaths after the date of admission and excluded in-hospital deaths, unless otherwise stated.

STATISTICS

Age-sex standardized incident and prevalence rates and the ninety-nine percent confidence intervals were calculated for newly diagnosed hospitalized and ambulatory congestive heart failure. Incidence was defined as the first hospitalizations in any of the study period years. Prevalence was defined as the first hospitalization in any of the study period years and that patient was then counted in all subsequent years until the end of the study period. Total hospitalizations were defined by counting all hospitalizations in all years during the entire study period. Incidence and prevalence for ambulatory diagnosis were similarly defined. Hospitalized or ambulatory incidences were mutually exclusive. The direct standardization method was used with the mid 1999/2000 population (average of 1998/1999 and 1999/2000) and the annual provincial age-sex rates (twenty to sixty-four years old, ten year increment afterwards up to eighty-four years old, eighty-five and over for each sex) as standard rates.

Bivariate and multivariate comparisons were done by chi-square and differences in variance as appropriate. Adjusted mortality and readmission rates were calculated using logistic regression and observed to expected ratios. We averaged the predicted probabilities in a given year (E). The observed rate of outcome (O) divided by the

expected rate (E) generated an O / E ratio for each year. The adjusted rates of outcome were calculated by multiplying each year's O / E ratio by the overall outcome rate. Adjusted lengths of stay and hospital costs per day were calculated using multiple regressions and least-square means. Covariates used for multiple regression adjustment included patient characteristics, severity of illness, comorbidity, and hospital volumes. In the analysis of length of stay, hospital costs, and readmission, in-hospital deaths were excluded. Modeling used SAS (Version 6.12) [SAS Institute Inc. Cary, NC 2000] and significance was defined as $p < 0.05$.

RESULTS

During the six years of the study, there were 16,162 hospitalizations for newly diagnosed congestive heart failure. These incident hospitalizations represent fifty percent of the total hospital admissions for congestive heart failure (n = 32,139), during the study period. The absolute number of incident hospitalizations gradually decreased over the study time period. Demographic features of the study population are given in Table 1. The cohort of patients with congestive heart failure was predominately elderly (mean age = 75.9 years) compared to the mean age of forty-four years in the 1998/1999 population of adults in Alberta. The age and sex distribution was similar between years. The distribution amongst hospitals types changed over time with rural hospitals accounted for fewer cases and metropolitan hospitals with angiography capability accounted for more cases in later years. Overall 65.5 percent in the cohort had one or more than one comorbidity. The distribution of patient comorbidity and congestive heart failure severity scores were similar between years (Table 2). Frequency of cardiac catheterizations, percutaneous transluminal coronary angioplasty / stenting, and coronary artery bypass surgery were low but increased over the study period. Frequency of specialist consultations for hospitalized patients also increased over the study time period (Table 3).

Unadjusted and adjusted outcomes are shown in Tables 4 and Table 5. Unadjusted length of hospital stay and readmissions were variable over the study time period. Adjusted length of hospital stay was similar between years. Adjusted readmissions were similar between years except for a steep decline in the last study year. Unadjusted and adjusted hospital costs were statistically higher over the study period but the dollar increase was small ($100 Canadian). Unadjusted and adjusted in-hospital and one-year mortality were similar between years.

Figures 1a to 1d demonstrate a small but statistically significant decline in the age-sex adjusted incident and prevalent hospitalization rates for congestive heart failure between 1994/1995 (incidence per 1,000 of 1.59; ninety-nine percent CI 1.51, 1.66: prevalence per 1,000 of 2.31; ninety-nine percent CI 2.22, 2.40) and the year 1999/2000 (incidence per 1,000 of 1.24; ninety-nine percent CI 1.18, 1.30: prevalence per 1,000 of

1.97; ninety-nine percent CI 1.89, 2.05). Crude hospitalization rate per 1,000 also demonstrated a small but statistically significant decline between 1994/1995 (2.98; ninety-nine percent CI 2.88, 3.08) and 1999/2000 (2.55; ninety-nine percent CI 2.46, 2.64). The age-sex adjusted incident rates of ambulatory diagnosis of congestive heart failure were similar throughout the 1994/1995 to1999/2000 time period (0.88; ninety-nine percent CI 0.82, 0.94 during 1994/1995 and 0.84; ninety-nine percent CI 0.79, 0.89 during 1999/2000). The crude mortality percentage for incident hospitalization for congestive heart failure was similar throughout the 1994/1995 to1999/2000 time period (31.0; ninety-nine percent CI 28.7, 33.3 during 1994/1995 and 28.6; ninety-nine percent CI 26.3, 30.9 during 1999/2000).

DISCUSSION

The principal finding in this study was a small decrease in the incident, prevalent, and total hospitalizations for congestive heart failure in the time period 1994/1995 to 1999/2000. The decrease was not the result of a substituted increase in incident ambulatory diagnosis for congestive heart failure. During the study period, there was a trend towards greater utilization of specialty health services (admission to metropolitan hospitals with angiography capability, internal medicine and cardiology specialist physician care, cardiac catheterization, percutaneous transluminal coronary angioplasty / stenting, coronary artery bypass surgery). One-year mortality for patients with newly diagnosed congestive heart failure was similar throughout the study period so that any therapeutic innovations were not accompanied by an overall decrease in mortality [15-17]. Many deaths in patients with congestive heart failure are not related to congestive heart failure [18] perhaps limiting the utility of these higher rates of health service high utilization [14]. This observational study cannot answer the pivotal questions as to why Alberta did not experience an increase in congestive heart failure hospitalizations as documented by others [1, 2, 7, 8, 11, 29, 30]. It is plausible that increased utilization of specialty health services (as noted in this cohort) for patients at high risk of developing congestive care (i.e. ischemic heart disease, hypertension) may have decreased the onset of new congestive heart disease [1, 9].

The focus of this study was new hospitalizations for patients with congestive heart failure. Hospitalization is an easily documented marker of congestive heart failure morbidity. The incident rates for congestive heart failure obtained by combining hospital and ambulatory incidence in this study are comparable to other cohort studies [15, 31, 32]. The rates from our cohort study were similar to longitudinal epidemiological studies [17, 33, 34]. The Framingham rates for congestive heart failure incidence in adults aged forty-five years and over were 4.7 cases per 1,000 in women and 7.2 cases per 1,000 men. The diagnosis of congestive heart failure in this study was made using ICD-9 codes extracted from hospital abstracts. Hospital discharge data may underestimate the true prevalence of the disease [35, 36]. The rate of hospitalization calculated in this study was similar to other studies using similar methodology

(i.e. abstracted hospital data) [15, 31, 32]. We extended our definition to include ambulatory internal medicine specialist and sub-specialist diagnosis but this did not demonstrate that incidence increased over time. Feldman used hospital abstracted data and [11] showed an increase in total hospitalizations including all readmissions in one Canadian city. In our present study, we did not note an increase in crude separation rate nor readmissions. Mortality rate was similar between years, and thus a change in mortality was not an explanation for the changes in hospitalization rates we observed. To our knowledge the only other investigators that have not noted an increase in hospitalizations for congestive heart failure was in Oregon during 1991 to 1995 [37].

This study has several limitations. Population-based administrative database research is highly generalizable although limited in clinical details. We attempted to adjust for case severity and comorbidity although these data may not have captured all-important variation. We constructed an episode of care by attributing readmissions within the first day of discharge back to the original index admission. Our length of stay was attributed to the presenting hospital rather than all hospitals in which could have been rendered.

In conclusion, we noted that the burden of congestive heart failure decreased in Alberta at a time when others have noted an increase. The comprehensive scope of medical care in Alberta allowed an assessment of the entire population with little loss of care provided in other jurisdictions. As well, we did not find an increase in non-hospitalized congestive heart failure as a possible compensation for the decrease in hospitalization. The reasons for the decrease are beyond the scope of this present study and must focus upon those at risk of developing the condition.

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FIGURE LEGEND

Figure 1a – Age-Sex Standardized Yearly Prevalence in Patients With Congestive Heart Failure

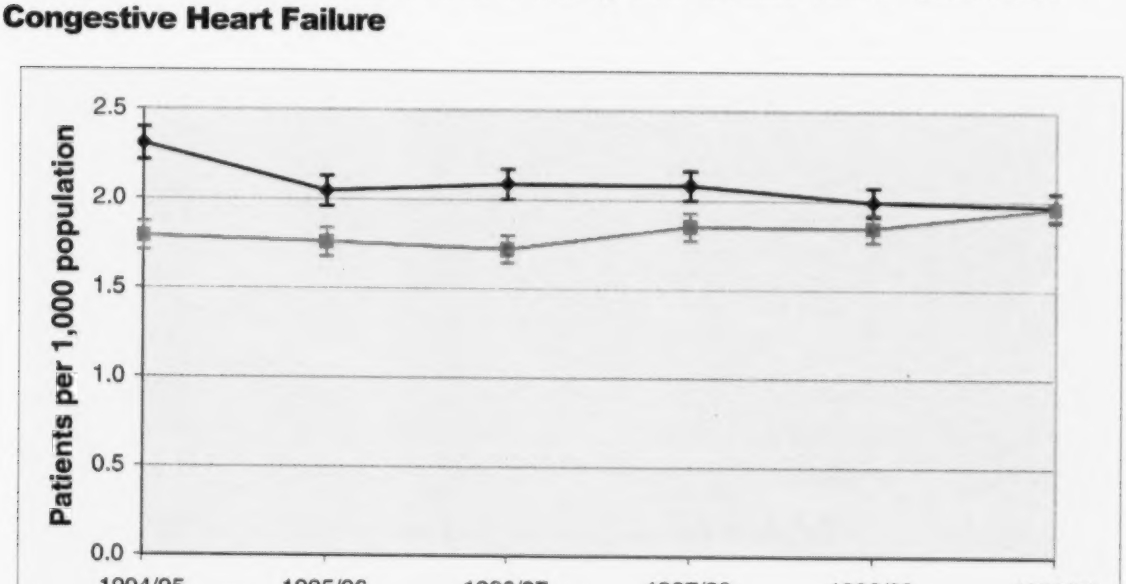

Figure 1b – Age-Sex Standarized Yearly Incidence in Patients With Congestive Heart Failure

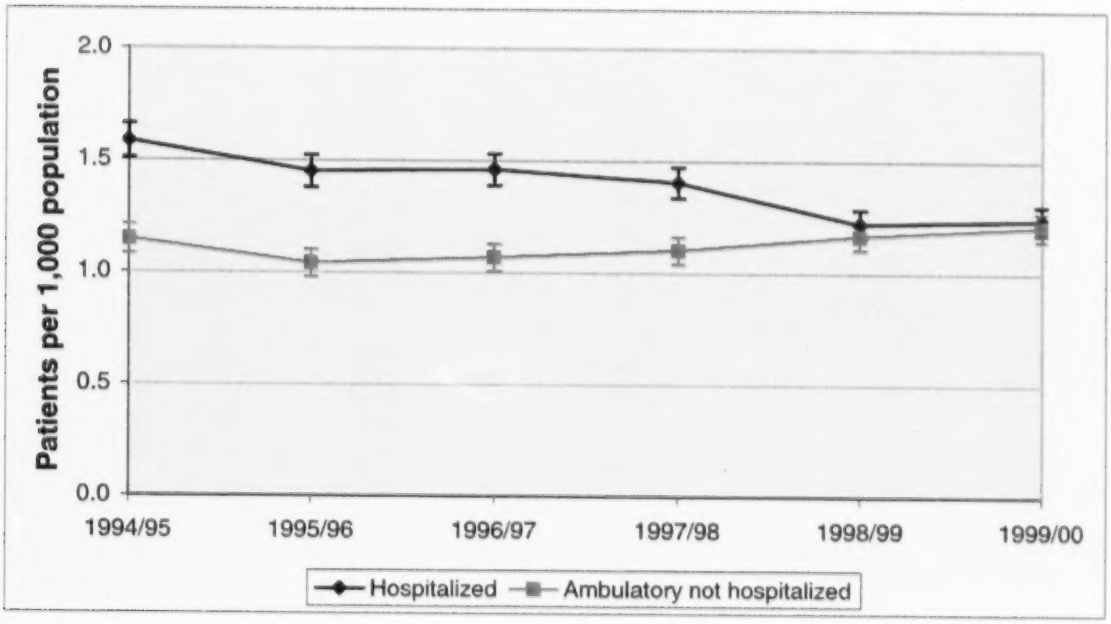

Figure 1c – One-Year Mortality Rate in Yearly Congestive Heart Failure Incidents

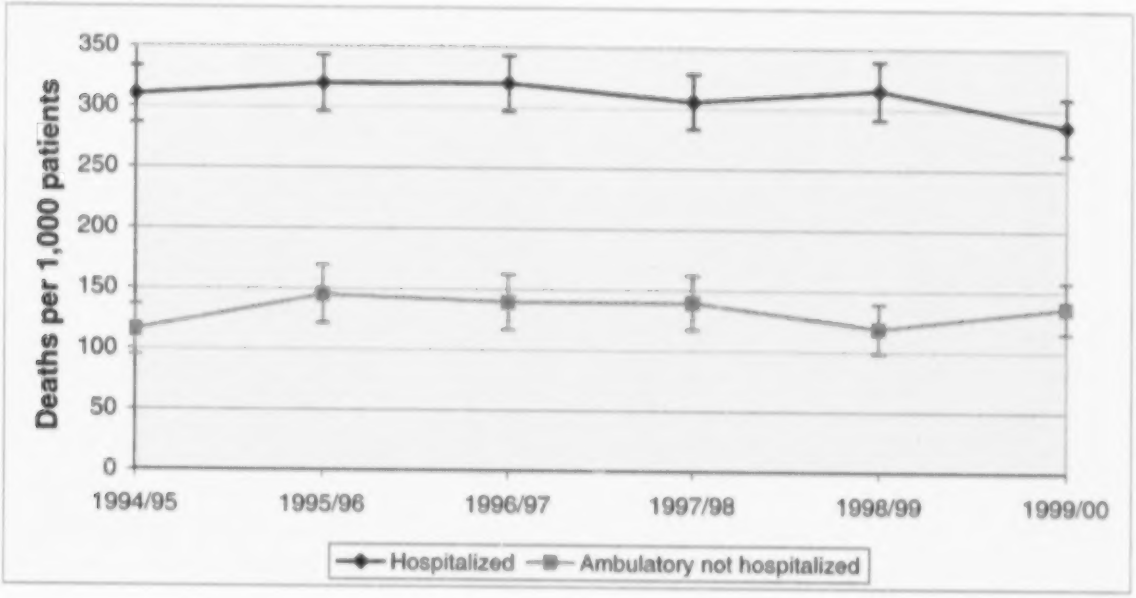

Figure 1d – Crude Hospital Discharge Rate in Patients With Congestive Heart Failure

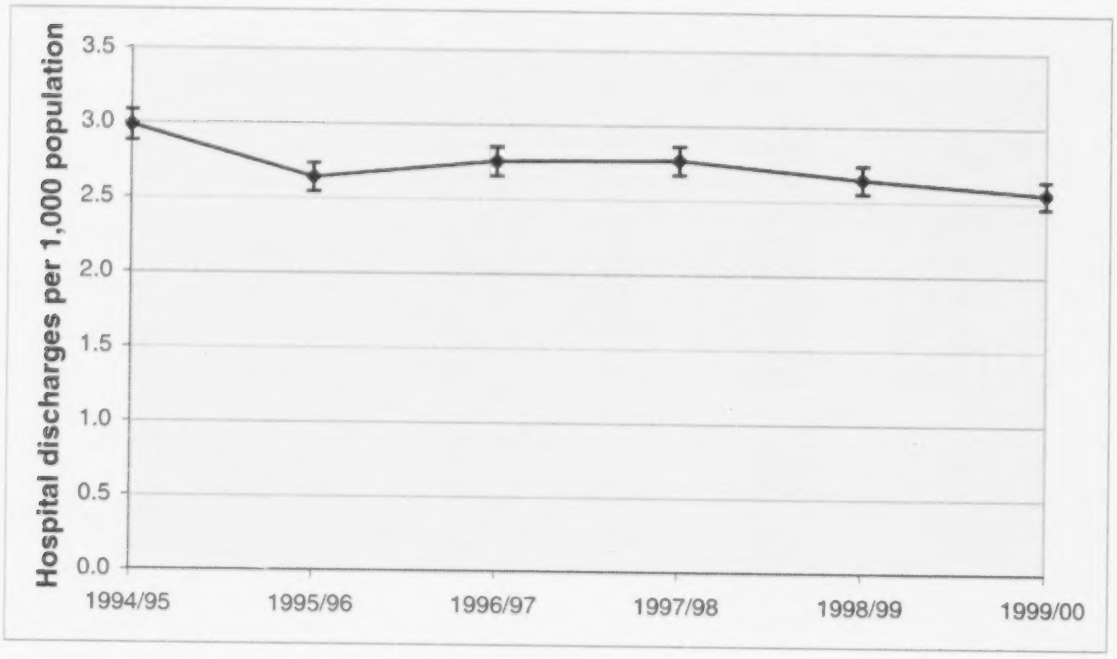

Table 1 – Patient Characteristics (Number and Percent) of Patients Hospitalized for Congestive Heart Failure in Alberta During 1994/1995 to 1999/2000

	Year 1994-1995	Year 1995-1996	Year 1996-1997	Year 1997-1998	Year 1998-1999	Year 1999-2000	All years
Annual incident hospital discharges	2,879 (17.8%)	2,688 (16.6%)	2,787 (17.2%)	2,765 (17.1%)	2,469 (15.3%)	2,574 (15.9%)	16,162
Mean age (std)	75.6 (11.7)	76.0 (11.9)	75.9 (12.0)	76.1 (11.8)	76.0 (12.1)	75.5 (12.2)	75.9 (11.9)
Sex; Female	1,429 (49.6%)	1,391 (51.7%)	1,450 (52.0%)	1,408 (50.9%)	1,236 (50.1%)	1,319 (51.2%)	8,233 (50.9%)
Metropolitan regions (Calgary and Edmonton)	1,170 (40.6%)	1,071 (39.8%)	1,161 (41.7%)	1,102 (39.9%)	1,061 (43.0%)	1,138 (44.2%)	6,703 (41.5%)
Export	209 (7.3%)	177 (6.6%)	213 (7.6%)	213 (7.7%)	193 (7.8%)	194 (7.5%)	1,199 (7.4%)
Hospital size							
Rural; less than 200 cases	740 (25.7%)	561 (20.9%)	583 (20.9%)	552 (20.0%)	498 (20.2%)	510 (19.8%)	3,444 (21.3%)
Rural; 200 to 646 cases	554 (19.2%)	620 (23.1%)	605 (21.7%)	614 (22.2%)	483 (19.6%)	487 (18.9%)	3,363 (20.8%)
Regional	344 (11.9%)	364 (13.5%)	358 (12.8%)	399 (14.4%)	342 (13.9%)	354 (13.8%)	2,161 (13.4%)
Metropolitan without angiography	624 (21.7%)	624 (23.2%)	682 (24.5%)	632 (22.9%)	585 (23.7%)	663 (25.8%)	3,810 (23.6%)
Metropolitan with angiography	617 (21.4%)	519 (19.3%)	559 (20.1%)	568 (20.5%)	561 (22.7%)	560 (21.8%)	3,384 (20.9%)

Table 2 – Patient Severity and Comorbidity (Number and Percent) of Patients Hospitalized for Congestive Heart Failure in Alberta During 1994/1995 to 1999/2000

	Year 1994-1995	Year 1995-1996	Year 1996-1997	Year 1997-1998	Year 1998-1999	Year 1999-2000	All years
Annual hospital discharges	2,879 (17.8%)	2,688 (16.6%)	2,787 (17.2%)	2,765 (17.1%)	2,469 (15.3%)	2,574 (15.9%)	16,162
Comorbidity (mean, std)	1.1 (1.0)	1.1 (1.0)	1.1 (1.0)	1.0 (1.0)	1.0 (1.0)	1.0 (1.0)	1.0 (1.0)
None	958 (33.3%)	905 (33.7%)	916 (32.9%)	986 (35.7%)	879 (35.6%)	934 (36.3%)	5,578 (34.5%)
One	1,122 (39.0%)	1,001 (37.2%)	1,092 (39.2%)	1,033 (37.4%)	930 (37.7%)	979 (38.0%)	6,157 (38.1%)
More than one	799 (27.8%)	782 (29.1%)	779 (28.0%)	746 (27.0%)	660 (26.7%)	661 (25.7%)	4,427 (27.4%)
Severity							
Anemia	443 (15.4%)	397 (14.8%)	435 (15.6%)	393 (14.2%)	390 (15.8%)	416 (16.2%)	2,474 (15.3%)
Electrolyte disturbance	302 (10.5%)	249 (9.3%)	272 (9.8%)	258 (9.3%)	244 (9.9%)	213 (8.3%)	1,538 (9.5%)
Coronary artery disease	1,139 (39.6%)	1,021 (38.0%)	1,060 (38.0%)	1,022 (37.0%)	904 (36.6%)	844 (32.8%)	5,990 (37.1%)
Hypertension	717 (24.9%)	689 (25.6%)	718 (25.8%)	783 (28.3%)	771 (31.2%)	830 (32.2%)	4,508 (27.9%)
Valvular heart disease	490 (17.0%)	422 (15.7%)	460 (16.5%)	436 (15.8%)	370 (15.0%)	387 (15.0%)	2,565 (15.9%)
Ventricular arrhythmia	117 (4.1%)	88 (3.3%)	105 (3.8%)	82 (3.0%)	87 (3.5%)	82 (3.2%)	561 (3.5%)
Hypotension and shock	51 1.8%)	46 (1.7%)	56 (2.0%)	43 (1.6%)	46 (1.9%)	52 (2.0%)	294 (1.8%)
Severity score (mean, std)	6.0 (3.3)	6.0 (3.3)	6.1 (3.4)	6.0 (3.2)	6.0 (3.4)	5.9 (3.4)	6.0 (3.3)

Table 3 – Patient Utilization of Resources (Number and Percent) for Patients Hospitalized for Congestive Heart Failure in Alberta During 1994/1995 to 1999/2000

	Year 1994-1995	Year 1995-1996	Year 1996-1997	Year 1997-1998	Year 1998-1999	Year 1999-2000	All years
Annual hospital discharges	2,879 (17.8%)	2,688 (16.6%)	2,787 (17.2%)	2,765 (17.1%)	2,469 (15.3%)	2,574 (15.9%)	16,162
Transferred to another acute care hospital	38 (1.3%)	33 (1.2%)	33 (1.2%)	34 (1.2%)	35 (1.4%)	40 (1.6%)	213 (1.3%)
Special care unit admission	482 (16.7%)	487 (18.1%)	515 (18.5%)	485 (17.5%)	481 (19.5%)	521 (20.2%)	2,971 (18.4%)
Cardiac catheterization	205 (7.1%)	207 (7.7%)	263 (9.4%)	231 (8.4%)	261 (10.6%)	271 (10.5%)	1,438 (8.9%)
Percutaneous transluminal coronary angioplasty / stent	27 (0.9%)	23 (0.9%)	31 (1.1%)	31 (1.1%)	40 (1.6%)	35 (1.4%)	187 (1.2%)
Coronary artery bypass surgery	38 (1.3%)	30 (1.1%)	44 (1.6%)	42 (1.5%)	44 (1.8%)	48 (1.9%)	246 (1.5%)
General / family practitioner listed as most responsible physician	1,980 (68.8%)	1,816 (67.6%)	1,860 (66.7%)	1,874 (67.8%)	1,537 (62.3%)	1,629 (63.3%)	10,696 (66.2%)
Any internal medicine specialist listed as consultant physician	1,418 (49.3%)	1,348 (50.1%)	1,412 (50.7%)	1,440 (52.1%)	1,335 (54.1%)	1,415 (55.0%)	8,368 (51.8%)
Any cardiologist specialist listed as consultant physician	592 (20.6%)	538 (20.0%)	576 (20.7%)	536 (19.4%)	510 (20.7%)	560 (21.8%)	3,312 (20.5%)

Table 4 – Unadjusted Outcomes (Number and Percent) for Patients Hospitalized for Congestive Heart Failure in Alberta During 1994/1995 to 1999/2000

	Year 1994-1995	Year 1995-1996	Year 1996-1997	Year 1997-1998	Year 1998-1999	Year 1999-2000	All years	P
Annual separations	n = 2,879 n [1] = 2,602 n [2] = 2,314	n = 2,688 n [1] = 2,457 n [2] = 2,381	n = 2,787 n [1] = 2,521 n [2] = 2,448	n = 2,765 n [1] = 2,509 n [2] = 2,487	n = 2,469 n = 2,221 n [1] = 2,212	n = 2,574 n [1] = 2,358 n [2] = 2,323	n = 16,162 n [1] = 14,668 n [2] =14,165	
LOS[1]; mean (std)	10.2 (23.5)	9.2 (14.2)	9.2 (10.3)	9.5 (12.9)	10.1 (13.2)	10.4 (16.0)	9.8 (15.7)	< 0.05
All cause 180-Days readmissions[1]	505 (19.4%)	480 (19.5%)	480 (19.0%)	499 (19.9%)	428 (19.3%)	357 (15.1%)	2,749 (18.7%)	< 0.001
In-hospital mortality	277 (9.6%)	231 (8.6%)	266 (9.5%)	256 (9.3%)	248 (10.0%)	216 (8.4%)	1,494 (9.2%)	> 0.05
One year mortality [2]	526 (22.7%)	603 (25.3%)	602 (24.6%)	582 (23.4%)	529 (23.9%)	510 (22.0%)	3,352 (23.7%)	> 0.05
Total hospital costs per stay[1] (in thousand dollars)	$4,307	$4,411	$4,387	$4,296	$4,503	$4,607	$4,414	< 0.01

[1] Excludes in-hospital deaths
[2] Excludes in-hospital deaths and those not in the registration database during the subsequent year

Table 5 – Adjusted Outcomes and Their Ninety-Five Percent Confidence Interval for Patients Selected Hospitalized Congestive Heart Failure in Alberta During 1994/1995 to 1999/2000

	Year 1994-1995	Year 1995-1996	Year 1996-1997	Year 1997-1998	Year 1998-1999	Year 1999-2000
Length of stay [1]	10.8 (10.2, 11.4)	9.8 (9.2, 10.5)	9.6 (9.0, 10.2)	9.9 (9.3, 10.5)	10.7 (10.1, 11.4)	10.5 (9.9, 11.2)
180-Days readmission [1]; n (%)	19.2 (17.7, 20.7)	19.2 (17.7, 20.8)	18.9 (17.4, 20.4)	19.8 (18.2, 21.3)	19.4 (17.8, 21.0)	15.5 (13.9, 17.1)
In-hospital mortality; n (%)	9.8 (8.8, 10.8)	8.5 (7.4, 9.5)	9.3 (8.3, 10.3)	9.5 (8.5, 10.5)	9.7 (8.6, 10.8)	8.4 (7.4, 9.5)
One-year mortality [2]; n (%)	22.7 (21.0, 24.4)	24.9 (23.3, 26.6	24.4 (22.8, 26.0)	23.6 (22.0, 25.2)	24.1 (22.4, 25.8)	22.4 (20.7, 24.1)
Total cost per hospital stay [1] (dollars)	$4,539 (4,415, 4,663)	$4,498 (4,370, 4,626)	$4,484 (4,358, 4,609)	$4,484 (4,358, 4,610)	$4,581 (4,447, 4,715)	$4,656 (4,525, 4,788)

[1] Excludes in-hospital deaths
[2] Excludes in-hospital deaths and those not in the registration database

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